

### **REMARKS**

Claims 1, 3, and 5 -10 are presently pending in the application.

Claim 1 has been amended to recite that the photo initiator for radical polymerization is sensitive to ultraviolet light. Support for this amendment may be found in the specification at least at page 1, last paragraph; page 10, lines 8-9; and page 27, lines 5-13. No new matter has been added by this amendment, and entry is respectfully requested.

In the Office Action, the Examiner has rejected claims 1, 3, 5-6, and 9-10 under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 5,776,634 of Ohkuma et al. ("Ohkuma") in view of WO 02/48101 of Date et al. ("Date"), relying on U.S. Patent Application Publication No. 2004/0030158 of Date as an English equivalent. The Examiner has also rejected claims 1, 3, 5, 6, and 10 under 35 U.S.C. § 103(a) as being obvious over U.S. Patent Application Publication No. 2003/0149124 of Thommes et al. ("Thommes) in view of Date. The Examiner has further rejected claims 1, 3, 5-6 and 9-10 under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 6,099,787 of Melisaris et al. ("Melisaris") in view of Date. Finally, the Examiner has rejected claims 7 and 8 under 35 U.S.C. §103(a) as obvious over Ohkuma et al. in view of Date and further in view of U.S. Patent Application Publication No. 2004/0137368 of Steinmann ("Steinmann"). Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

#### **Rejection Under § 103(a) Based on Ohkuma in view of Date**

Regarding claims 1, 3, and 10, the Examiner argues that in the abstract, Ohkuma teaches a photosensitive recording medium composition containing a radical-polymerizable monomer, a cationic-polymerizable monomer, a radical polymerization initiator and a cationic-polymerization initiator. The cationic initiator may allegedly be represented by formula (I) which the Examiner contends is equivalent to claimed formula (I) when Ar is a phenyl group. The Examiner further argues that specific formula (II) of Ohkuma is equivalent to claimed formula (I) when M is a phosphorus atom. The Examiner acknowledges that Ohkuma does not teach the claimed purity of the cationic polymerization initiator.

However, the Examiner argues that Date teaches a method of manufacturing sulfonium salts used as photocationic polymerization initiators for resists. In Examples 1-3, Date allegedly discloses the synthesis of (4-phenylthiophenyl)diphenylsulfonium hexafluorophosphate with a purity of 99% and further that analyses indicated that the product comprised small amounts of raw materials, such as diphenyl sulfoxide and diphenyl sulfide. Similar impurities are allegedly described in Example 5 for the synthesis of (4-phenylthiophenyl)diphenylsulfonium hexafluoroantimonate. The Examiner argues that there is no compound represented by claimed formula (II) in the products described by Date and therefore concludes that the limitations of claims 1 and 10 for the quantity of compound of formula (II) are met. The Examiner takes the position that it would have been obvious for one skilled in the art at the time of the invention to use the sulfonium salts with a purity of 99% obtained in the process of Date as photocationic polymerization initiators in the composition of Ohkuma since Date specifically indicates this use for such high-purity sulfonium salts.

The Examiner also takes the position that the proposed combination of Ohkuma and Date teaches or suggests all of the elements of dependent claims 5 and 6. Regarding claim 9, the Examiner argues that the product described in Example 5 of Date has a purity of more than 99% so that the raw materials are present in an amount of less than 1%. The Examiner contends that since the raw materials for the synthesis of 4-phenylthiophenyldiphenylsulfonium hexafluoroantimonate and 4-phenylthiophenyldiphenylsulfonium hexafluorophosphate comprise about 30% diphenylsulfoxide, it would have been expected that the mixture of raw materials left as residues in the synthesis of these compounds would comprise about 30% diphenylsulfide and thus the product would comprise less than 0.3% of diphenylsulfoxide, which encompasses the claimed range. Accordingly, the Examiner concludes that the present claims are obvious. Applicants respectfully traverse this rejection as follows.

The presently claimed actinic radiation-curable resin composition for stereolithography includes a cationic polymerizable organic compound, a radical polymerizable organic compound, a photo initiator for radical polymerization which is sensitive to ultraviolet light, and a photo initiator for cationic polymerization which contains a highly pure (97 weight % or higher) compound represented by formula (I) and less than 3% by mass of a compound represented by formula (II). This compound is highly pure to improve the aging stability during operation and

the storage stability of the composition. Applicants have determined that the stability of the composition may be dramatically improved by increasing the ratio of compound having formula (I) to compound having formula (II), that is, preferably substantially excluding compounds of formula (II).

Ohkuma is directed to a photosensitive recording medium and a method of preparing a hologram using it. In Example 1, Ohkuma discloses a composition containing 4-phenylthiophenyldiphenylsulfonium hexafluorophosphate as a cationic polymerization initiator, a radical polymerization initiator, a radical-polymerization compound, and a cationic polymerization compound. However, the radical polymerization initiator of Ohkuma is sensitive to visible light (col. 8, lines 60-62), which is taught to be desirable for hologram recording.

Further, one skilled in the art would not have been motivated to utilize the composition disclosed in Ohkuma as a composition for stereolithography as claimed for the following reasons.

In Example 1 of Ohkuma, the recording medium is exposed to light from a 500-W Xe lamp at a distance of 20 cm from the recording medium for 10 seconds, so as to obtain a cured layer having a thickness of 10  $\mu\text{m}$ . That is, a very high amount of energy is required to cure the composition so that it is not necessary for the composition of Ohkuma to have high sensitivity to light.

In compositions for stereolithography as claimed, sensitivity to light is important. In contrast with the Ohkuma compositions, the claimed compositions for stereolithography were exposed to light with energy of 20-30  $\text{mJ}/\text{cm}^2$  to produce a cured layer having a thickness of 100  $\mu\text{m}$  (Example 1 of present application). In general, a composition for stereolithography must be exposed to light with an energy of 10-200  $\text{mJ}/\text{cm}^2$  to produce a cured layer having a thickness of 100  $\mu\text{m}$ . In stereolithography, it is necessary to cure photosensitive compositions upon exposure to laser light for a short time to produce a cured layer having a thickness of 100  $\mu\text{m}$  or more. Accordingly, high light sensitivity is required for compositions for stereolithography.

It is well known that when performing cationic polymerization of epoxy resins, curing of the resin progresses gradually due to a dark reaction that occurs after completion of exposure of

the resin to light. In stereolithography, when a second layer is stacked on the cured layer, it is necessary for the cured layer to cure to a sufficient degree in a short time, such as 2-3 seconds, that it can support the weight of a second stacked layer. From this standpoint, one skilled in the art would understand that a second resin composition for stereolithography must have a fast curing reaction speed (i.e., high sensitivity to light).

The composition disclosed in Example 1 of Ohkuma contains ethyl-p-diethylamine benzoate in an amount of 1 wt% and 35 wt% of a urethane compound which works as a weak base. These compounds capture protons generated from a cationic polymerization initiator to inhibit curing and to reduce sensitivity and polymerization speed. Therefore, it is well known to those skilled in the art that such compounds should not be added to compositions for stereolithography. From this standpoint, the composition of Ohkuma is substantially different from a composition for stereolithography. Accordingly, it would not have been obvious based on Ohkuma for one skilled in the art at the time of the invention to apply (4-phenylthiophenyl)diphenylsulfonium hexafluorophosphate or -antimonate to a composition for stereolithography, as suggested by the Examiner.

The radical- and cationic polymerization initiators of Ohkuma have different sensitivities to light, and thus are not polymerized at the same time. On the other hand, in stereolithography, a radical-cationic hybrid resin is used which is characterized in that radical and cationic polymerization proceed simultaneously.

Radical polymerization proceeds very rapidly, which is advantageous in providing resolution of patterns in the cured resin. However, the volume shrinkage of the cured resin is large and internal stress in the cured resin cannot be released due to the high reaction speed. Thus, when a resin having a thickness of 0.1 mm or more is cured, the resin becomes warped due to curl distortion, and thus it is difficult to obtain the intended shape of the resin.

In cationic polymerization, protons are generated from an initiator and dark reaction proceeds using the proton as living species. Since the reaction proceeds more slowly than does radical polymerization, internal stress can be released. Also, the volume shrinkage is small and thus it is possible to prevent the cured resin from being warped. However, due to the slow reaction speed, it is difficult to obtain sufficient strength for a short period to start polymerization

at the next layer. Further, even after completion of light irradiation, proton diffusion continues to cure portions not exposed to light and intended shapes of the resin cannot be obtained.

Finally, in hybrid polymerization (cationic and radical polymerization proceeding simultaneously), a cured pattern is specified by radical polymerization at the early period of the reaction and cationic and radical polymerization gradually proceed in the specified pattern portion. As a result, both high resolution and small curl distortion can be achieved. Further, the temperature of the system rises due to the reaction heat of radical polymerization, thus accelerating the speed of the dark reaction of cationic polymerization, which is a heat reaction.

In conclusion, in the system of the presently claimed invention, radical and cationic polymerization are performed simultaneously. This is a different system than that of Ohkuma, in which radical and cationic polymerization are performed separately.

For at least these reasons, no *prima facie* case of obviousness has been established based on the proposed combination of Ohkuma with Date, and reconsideration and withdrawal of the § 103(a) rejection are respectfully requested.

Rejection Under § 103(a) Based on Thommes in view of Date

Regarding claims 1, 3, and 10, the Examiner argues that Thommes teaches a radiation curable resin comprising both radically and cationically polymerizable components and also radical and cationic photoinitiators, wherein one of the preferred cationic photoinitiators is represented by formula (III). The Examiner acknowledges that Thommes does not specifically disclose the compound of claimed formula (I).

However, based on the alleged teachings of Date, described above, the Examiner takes the position that it would have been obvious to one having ordinary skill in the art at the time of the invention to use a sulfonium salt, such as (4-phenylthiophenyl)diphenylsulfonium hexafluorophosphate or (4-phenylthiophenyl)diphenylsulfonium hexafluoroantimonate with a purity of 99% obtained in the process of Date as photocationic polymerization initiators in the composition of Thommes since Date specifically indicates such a use for these high-purity compounds and since the sulfonium salts of Date allegedly meet the conditions of general

formula (III) of Thommes. The Examiner also argues that Thommes teaches the elements of dependent claims 5 and 6. Applicants respectfully traverse this rejection as follows.

Thommes teaches a radiation curable resin composition comprising at least one epoxy resin and a cationic photoinitiator or a radiation curable component, a photoinitiator, and a filler. The composition may contain cationically and/or radically curable components as well as cationic photoinitiators and/or radical photoinitiators (paragraph [0017]). The resin composition in Examples 8-10 of Thommes contains "CPI-6976" (identical to "UVI-6976") as a cationic polymerization initiator. As shown in the Material Safety Data Sheet for UVI-6976 attached hereto, CPI-6976 is a mixture of a compound corresponding to claimed formula (I) and a compound corresponding to claimed formula (II).

As demonstrated previously on the record, Applicants have empirically determined that the purity of the sulfonium compound of Formula (I) in UVI 6974 is at most 50%, and similar results would be expected for the purity of the sulfonium compound of Formula (II) in UVI-6976. Further, it may be seen by comparing the compounds represented by formulas (I) and (II) that the compound represented by formula (II) has superior performance as a photo initiator (e.g., reactivity) since it is bifunctional. Accordingly, if one skilled in the art wanted to improve the purity of the compound of Formula (I) or (II), he would attempt to improve the purity of the latter compound, that is, the compound with superior reactivity. In other words, one skilled in the art looking to modify the method of Thommes would not have been motivated to improve the purity of the formula (I) compound (such as by utilizing the compound of Date), but rather would have been motivated to improve the purity of the formula (II) compound. Therefore, the proposed combination of Thommes with Date is not proper.

Additionally, although Date indeed discloses a highly pure sulfonium salt represented by formula (I), the object of Date is to provide a method for manufacturing high-purity sulfonium salts in good yield. Date does not teach or suggest the long-term storage stability of a resin composition for stereolithography. Accordingly, one skilled in the art would not have expected from Date that the compound represented by formula (I) has advantageous effects on the long-term storage stability of resin compositions for stereolithography. Therefore, the results exhibit

by the presently claimed invention would not have been expected based on the proposed combination of Thommes and Date.

In conclusion, although Date discloses a highly-pure compound represented by formula (I), it would not have been obvious to one having ordinary skill in the art at the time of the invention to have used the compound of Date in the resin composition of Thommes in order to improve long-term storage stability of the resin composition, nor would the results exhibited by the presently claimed composition have been expected. Accordingly, the present claims would not have been obvious based on the proposed combination of Thommes and Date.

Applicants note the Examiner's comments in the present Office Action regarding the prior rejection based on Steinmann in view of Date. The Examiner acknowledges that Applicants have shown that the highly pure compound of formula (I) improves the aging stability during operation and the storage stability of the composition. This is supported by Examples 1 and 2 and Comparative Examples 1 and 2 of the application, in which the Comparative Examples comprise the cationic photoinitiator UVI 6974 (same as Steinmann). Applicants respectfully submit that in view of the above comments and such acknowledgements, reconsideration and withdrawal of the §103(a) rejection based on Thommes in view of Date are respectfully requested.

*Rejection Under §103(a) Based on Melisaris in view of Date*

Regarding claims 1, 3, and 10, the Examiner argues that Melisaris discloses a radiation-curable composition comprising a mixture of at least one radiation cationically polymerizable compound and/or at least one free radical polymerizable compound, and at least one photoinitiator for cationic and/or radical polymerization. The particularly preferable systems are allegedly hybrid systems, i.e., compositions which contain at least one compound which can be cured by means of free radicals and a free-radical polymerization initiator, as well as the cationically curable components. The Examiner argues that the photoinitiator for cationic polymerization may be an onium salt represented by general formula (3), but acknowledges that Melisaris does not specifically disclose the compound of claimed formula (I).

However, in view of the teachings of Date, set forth above, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to use a sulfonium salt, such as (4-phenylthiophenyl)diphenylsulfonium hexafluorophosphate or (4-phenylthiophenyl)diphenylsulfonium hexafluoroantimonate, with a purity of 99% obtained in the process of Date as a photocationic polymerization initiator in the composition of Melisaris since Date specifically indicates this use for the high-purity sulfonium salts and since the sulfonium salts of Date allegedly meet the conditions of general formula (3) of Melisaris. The Examiner also argues that the proposed combination of Melisaris and Date teaches or suggests the elements of dependent claims 5, 6, and 9. Applicants respectfully traverse this rejection as follows.

Melisaris describes a radiation curable composition comprising at least one cationically polymerizable compound and/or at least one free radical polymerizable compound, at least one filler material, and at least one photoinitiator for cationic and/or radical polymerization. An organic viscosity stabilizer material is used to control viscosity increases and premature polymerization. Melisaris utilizes UVI-6974 as a photoacid precursor (substantially equivalent to a cationic photopolymerization initiator) in col. 10, lines 46-47. As previously demonstrated, this material contains the compound having claimed formula (I) with a purity of at most 50% and the compound having claimed formula (II). As previously explained, if one skilled in the art wanted to improve the purity of the compounds of Formula (I) or (II), he would attempt to improve the purity of the latter compound, that is, the compound with superior reactivity. In other words, one skilled in the art who was looking to modify the method of Melisaris would not have been motivated to improve the purity of the formula (I) compound (such as by utilizing the compound of Date), but rather would have been motivated to improve the purity of the formula (II) compound. In fact, in Melisaris, the stability is improved by BDMA, as shown in Table 3 ("116-9A" and 116-13A-C"). By adding BDMA in an appropriate amount, the viscosity change after aging at 65°C is reduced. Therefore, the proposed combination of Melisaris with Date is not proper.

Additionally, although Date indeed discloses a highly pure sulfonium salt represented by formula (I), the object of Date is to provide a method for manufacturing high-purity sulfonium salts in good yield. Date does not teach or suggest the long-term storage stability of a resin composition for stereolithography. Accordingly, one skilled in the art would not have expected



from Date that the compound represented by formula (I) has advantageous effects on the long-term storage stability of resin compositions for stereolithography. That is, the results exhibit by the presently claimed invention would not have been expected based on the proposed combination of Melisaris and Date.

In conclusion, although Date discloses a highly-pure compound represented by formula (I), it would not have been obvious for one having ordinary skill in the art at the time of the invention to have used the compound of Date in the resin composition of Melisaris in order to improve long-term storage stability of the resin composition, nor would the results exhibited by the presently claimed composition have been expected. Accordingly, the present claims would not have been obvious based on the proposed combination of Melisaris and Date.

Applicants again note the Examiner's comments in the present Office Action regarding the prior rejection based on Steinmann in view of Date and the Examiner's withdrawal of the rejection based on Steinmann in view of Date. Since Melisaris, like Steinmann, teaches the inclusion of UVI-6974, Applicants respectfully request reconsideration and withdrawal of the §103(a) rejection based on Melisaris in view of Date.

*Rejection Under § 103(a) Based on Ohkuma in view of Date and Steinmann*

Finally, regarding claims 7 and 8, the Examiner acknowledges that the proposed combination of Ohkuma and Date does not teach that the composition comprises an oxetane compound and a polyalkylene ether compound as claimed. However, Steinmann allegedly teaches a radiation-curable composition useful for the production of three dimensional articles by stereolithography comprising at least one cationically polymerizing organic substance, at least one free-radical polymerizing organic substance, at least one cationic polymerization initiator, at least one free-radical polymerization initiator, at least one hydroxyl-functional compound, and at least one hydroxyl-functional oxetane compound. Steinmann allegedly discloses in Example 1 that 3-ethyl-3-hydroxymethyl-oxetane (Cyracure UVR 6000) is comprised in the radiation-curable composition at a ratio of 26.78 wt% with respect to the Cyracure UVR 6110, and further that the one hydroxyl-functional compound (E) may be propylene glycols of various molecular weights, glycerine propoxylated polyether triol and polyethyleneglycols. These compounds are allegedly equivalent to the claimed polyalkylene ether compounds. The Examiner further argues

that in Example 1 Steinmann specifically discloses that glycerine propoxylated polyether triol is comprised in the radiation curable composition at a ratio of 17.85% with respect to 3,4-epoxycyclohexylmethyl-3',4'-epoxycyclohexane carboxylate (Cyracure UVR 6100).

Accordingly, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to add at least one hydroxyl-functional compound, such as propylene glycols of various molecular weights, glycerine propoxylated polyether triol and polyethyleneglycols and at least one hydroxyl-functional oxetane compound, as disclosed by Steinmann, to the composition of Ohkuma/Date in order to obtain a composition with exceptionally high photospeed, low viscosity, low humidity sensitivity, and high temperature resistance since such properties are taught by Steinmann. Applicants respectfully traverse this rejection as follows.

As previously explained on the record, Ohkuma does not teach or suggest all of the claimed elements, including a composition for stereolithography comprising a photoinitiator for radical polymerization that is sensitive to ultraviolet light, and even the proposed combination with Date and Steinmann would not cure such a deficiency. That is, even utilizing an oxetane or polyalkylene ether compound in the composition of Ohkuma would not result in a composition for stereolithography containing the claimed photoinitiator. Accordingly, reconsideration and withdrawal of the §103(a) rejection based on Ohkuma in view of Date and Steinmann are respectfully requested.

In view of the preceding Amendments and Remarks, it is respectfully submitted that the pending claims are patentably distinct from the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Application No. 10/562,098  
Reply to Office Action of August 19, 2008

Respectfully submitted,  
**Takashi ITO, et al.**

December 19, 2008  
(Date)

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Enclosures: Petition for Extension of Time (one-month)  
MSDS for UVI-6976



UNION CARBIDE CORPORATION  
A Subsidiary of The Dow Chemical Company  
**MATERIAL SAFETY DATA SHEET**



Product Name: CYRACURE(TM) PHOTOINITIATOR  
UVI-6976  
MSDS#: 828

Effective Date: 01/22/2001

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Union Carbide urges each customer or recipient of this MSDS to study it carefully to become aware of and understand the hazards associated with the product. The reader should consider consulting reference works or individuals who are experts in ventilation, toxicology, and fire prevention, as necessary or appropriate to use and understand the data contained in this MSDS.

To promote safe handling, each customer or recipient should: 1) Notify its employees, agents, contractors and others whom it knows or believes will use this material of the information in this MSDS and any other information regarding hazards or safety; 2) Furnish this same information to each of its customers for the product; and 3) Request its customers to notify their employees, customers, and other users of the product of this information.

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

### 1.1 IDENTIFICATION

Product Name	CYRACURE(TM) PHOTOINITIATOR UVI-6976
Chemical Name	Not applicable (mixture)
Chemical Family	Not applicable (mixture)
Formula	Not applicable (mixture)
Synonym	None

### 1.2 COMPANY IDENTIFICATION

Union Carbide Corporation  
A Subsidiary of The Dow Chemical Company  
39 Old Ridgebury Road  
Danbury, CT 06817-0001

### 1.3 EMERGENCY TELEPHONE NUMBER

24 hours a day: CHEMTREC 1-800-424-9300.  
Number for non-emergency questions concerning MSDS (732) 563-5522  
Additional information on this product may be obtained by calling the Union Carbide Corporation Customer Service Center at 1-800-568-4000.

## **MATERIAL SAFETY DATA SHEET**

Product Name: CYRACURE(TM) PHOTOINITIATOR  
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### **2. COMPOSITION INFORMATION**

Component	CAS #	Amount (%W/W)
Sulfonium,(thiodi-4,1-phenylene) bis[diphenyl-bis[(OC-6-11)hexafluoroantim onate(1-)]	89452-37-9	<= 50%
p-Thiophenoxyphenyldiphenylsulfonium hexafluoroantimonate	71449-78-0	<= 50%
Propylene carbonate	108-32-7	<= 50%

### **3. HAZARDS IDENTIFICATION**

#### **3.1 EMERGENCY OVERVIEW**

Appearance Pale yellow to amber

Physical State Liquid

Odor Hydrocarbon

Hazards of product WARNING! CAUSES EYE IRRITATION.  
MAY CAUSE ALLERGIC SKIN REACTION.

#### **3.2 POTENTIAL HEALTH EFFECTS**

##### **Effects of Single Acute Overexposure**

Inhalation Short-term harmful health effects are not expected from vapor generated at ambient temperature.

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**Eye Contact** Injury to the cornea is not expected. Liquid causes irritation, experienced as stinging, excess blinking and tear production, with excess redness and swelling of the conjunctiva.

**Skin Contact** Brief contact may cause slight irritation with itching and local redness.

**Skin Absorption** No evidence of harmful effects from available information.

**Swallowing** Low toxicity. May cause nausea.

### **Chronic, Prolonged or Repeated Overexposure**

**Effects of Repeated Overexposure** Skin contact may cause sensitization and an allergic skin reaction.

**Other Effects of Overexposure** Curing of this product may release trace amounts of diphenyl sulfide, which has a nuisance odor. Overexposure to diphenyl sulfide may cause a subjective sensory response to the odor. Symptoms may include headache, nausea, light-headed sensation, abdominal discomfort or coughing. These symptoms do not typically reflect a toxic response to the product, and will generally self-resolve upon cessation of exposure.

### **Medical Conditions Aggravated by Exposure**

A knowledge of the available toxicology information and of the physical and chemical properties of the material suggests that overexposure is unlikely to aggravate existing medical conditions.

## **3.3 POTENTIAL ENVIRONMENTAL EFFECTS**

See Section 12 for Ecological Information.

## **4. FIRST AID PROCEDURES**

### **4.1 INHALATION**

Remove to fresh air.

### **4.2 EYE CONTACT**

Immediately flush eyes with water and continue washing for several minutes. Remove contact lenses, if worn. Obtain medical attention if discomfort persists.

### **4.3 SKIN CONTACT**

Remove contaminated clothing. Wash skin with soap and water. If irritation persists or if contact has been prolonged, obtain medical attention.

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### **4.4 SWALLOWING**

If a large quantity (several ounces) has been swallowed, and if patient is fully conscious, give two glasses of water. Induce vomiting. This should be done only by medical or experienced first-aid personnel. Obtain medical attention.

### **4.5 NOTES TO PHYSICIAN**

There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

Slight skin irritant.

Slight eye irritant.

Low toxicity by swallowing.

## **5. FIRE FIGHTING MEASURES**

### **5.1 FLAMMABLE PROPERTIES**

Flash Point - Closed Cup: *Pensky-Martens Closed Cup ASTM D 93* > 140 °C >  
284 °F

Flash Point - Open Cup: *Not currently available.*

Autoignition Temperature: *Not currently available.*

#### **Flammable Limits In Air:**

Lower	2.3 %(V)
Upper	<i>Not determined.</i>

### **5.2 EXTINGUISHING MEDIA**

Extinguish fires with water spray or apply alcohol-type or all-purpose-type foam by manufacturer's recommended techniques for large fires. Use carbon dioxide or dry chemical media for small fires.

### **5.3 EXTINGUISHING MEDIA TO AVOID**

No information currently available.

### **5.4 SPECIAL FIRE FIGHTING PROCEDURES**

No information currently available.

### **5.5 SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS**

Use self-contained breathing apparatus and protective clothing.

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### **5.6 UNUSUAL FIRE AND EXPLOSION HAZARDS**

During a fire, hydrogen fluoride may be produced.  
See Section 8.3 - Engineering Controls

### **5.7 HAZARDOUS COMBUSTION PRODUCTS**

May give off hydrogen fluoride gas if exposed to mineral acids or flame. Hydrogen fluoride can cause redness of skin and some burning and irritation of the nose and eyes at concentrations above 3 ppm in air (TLV = 3 ppm C).

## **6. ACCIDENTAL RELEASE MEASURES**

### **Steps to be Taken if Material is Released or Spilled:**

Collect for disposal.

**Personal Precautions:** Wear suitable protective equipment.      Avoid contact with eyes and skin.  
See Section 8.2 - Personal Protection.

## **7. HANDLING AND STORAGE**

### **7.1 HANDLING**

#### **General Handling**

Avoid contact with eyes, skin, and clothing.  
Keep container closed.  
Use with adequate ventilation.  
Wash thoroughly after handling.

**FOR INDUSTRY USE ONLY.**

#### **Ventilation**

General (mechanical) room ventilation is expected to be satisfactory.

### **7.2 STORAGE**



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Store in accordance with good industrial practices. Storage information may be obtained from product-specific Union Carbide Storage and Handling Guides, or by calling a Union Carbide Customer Service Representative.

### **8. EXPOSURE CONTROLS AND PERSONAL PROTECTION**

#### **8.1 EXPOSURE LIMITS**

None established by OSHA, ACGIH or UCC.

#### **8.2 PERSONAL PROTECTION**

**Respiratory Protection:** Use self-contained breathing apparatus in high vapor concentrations.

**Ventilation:** General (mechanical) room ventilation is expected to be satisfactory.

**Eye Protection:** Safety glasses or monogoggles

**Protective Gloves:** Neoprene

**Other Protective Equipment:** Eye Bath, Safety Shower

#### **8.3 ENGINEERING CONTROLS**

**PROCESS HAZARD:** Sudden release of hot organic chemical vapor or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into hot equipment under a vacuum, may result in ignitions without the presence of obvious ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Any use of this product in elevated-temperature processes should be thoroughly evaluated to establish and maintain safe operating conditions. Further information is available in a technical bulletin entitled "Ignition Hazards of Organic Chemical Vapor."

Trace amounts of benzene may be generated during ultraviolet (UV) curing of this material. The amount of benzene generated is dependent upon formulation parameters, process conditions and temperature. Benzene is a known human carcinogen and is included in the IARC, NTP and OSHA lists of carcinogens. Local ventilation is recommended for control of airborne vapor.

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### **9. PHYSICAL AND CHEMICAL PROPERTIES**

Physical State: Liquid

Appearance: Pale yellow to amber

pH: *Not currently available.*

Solubility in Water (by weight): Insoluble

Odor: Hydrocarbon

Flash Point - Closed Cup: *Pensky-Martens Closed Cup ASTM D 93* > 140 °C > 284 °F

Percent Volatiles: ~ 50 Wt% Solvent

Boiling Point (760 mmHg): > 220 °C > 428 °F

Freezing Point: *Not applicable.*

Specific Gravity (H<sub>2</sub>O = 1): 1.4 25 °C / 25 °C

Vapor Pressure at 20°C: < 0.004 kPa < 0.03 mmHg

Vapor Density (air = 1): > 1

Evaporation Rate (Butyl Acetate = 1): < 0.01

Melting Point: *Not applicable.*

### **10. STABILITY AND REACTIVITY**

10.1 STABILITY/INSTABILITY Stable

Conditions to Avoid: Contact with excessive heat, open flame, sparks, or ignition sources.  
Exposure to sunlight, or ultraviolet light. Fluorescent light.

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**Incompatible Materials:** Mineral acids.

**Hazardous Decomposition Products:** May give off hydrogen fluoride gas if exposed to mineral acids or flame. Hydrogen fluoride can cause redness of skin and some burning and irritation of the nose and eyes at concentrations above 3 ppm in air (TLV = 3 ppm C).

**10.2 HAZARDOUS POLYMERIZATION** Will Not Occur.

**10.3 INHIBITORS/STABILIZERS** Not applicable.

### **11. TOXICOLOGICAL INFORMATION**

#### **SIGNIFICANT DATA WITH POSSIBLE RELEVANCE TO HUMANS**

This material was mutagenic in the Ames bacterial assay. It is inactive, however, in the in vivo mouse micronucleus test.

### **12. ECOLOGICAL INFORMATION**

#### **12.1 ENVIRONMENTAL FATE**

Information may be available, call Union Carbide.

#### **12.2 ECOTOXICITY**

Information may be available, call Union Carbide.

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### **12.3 FURTHER INFORMATION**

None.

## **13. DISPOSAL CONSIDERATIONS**

### **13.1 WASTE DISPOSAL METHOD**

Incinerate in a furnace where permitted under Federal, State, and local regulations. Dispose in accordance with all applicable Federal, State, and local environmental regulations. Empty containers should be recycled or disposed of through an approved waste management facility.

### **13.2 DISPOSAL CONSIDERATIONS**

See Section 13.1

*Disposal methods identified are for the product as sold. For proper disposal of used material, an assessment must be completed to determine the proper and permissible waste management options permissible under applicable rules, regulations and/or laws governing your location.*

## **14. TRANSPORT INFORMATION**

### **14.1 U.S. D.O.T.**

#### **NON-BULK**

Proper Shipping Name : NOT REGULATED

#### **BULK**

Proper Shipping Name : NOT REGULATED

*This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.*

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### **15. REGULATORY INFORMATION**

#### **15.1 FEDERAL/NATIONAL**

##### **COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 SECTION 103 (CERCLA)**

The following components of this product are specifically listed as hazardous substances in 40 CFR 302.4 (unlisted hazardous substances are not identified) and are present at levels which could require reporting:

None.

##### **SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 TITLE III (EPCRA) SECTIONS 302 AND 304**

The following components of this product are listed as extremely hazardous substances in 40 CFR Part 355 and are present at levels which could require reporting and emergency planning:

None.

##### **SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 TITLE III (EPCRA) SECTION 313**

The following components of this product are listed as toxic chemicals in 40 CFR 372.65 and are present at levels which could require reporting and customer notification under Section 313 and 40 CFR Part 372:

Component	CAS #	Amount
Antimony compounds	Not available	<= 50.0000%

##### **SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 TITLE III (EPCRA) SECTIONS 311 AND 312**

Delayed (Chronic) Health Hazard : Yes  
Fire Hazard : No  
Immediate (Acute) Health Hazard : Yes  
Reactive Hazard : No  
Sudden Release of Pressure Hazard : No

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### **TOXIC SUBSTANCES CONTROL ACT (TSCA)**

All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements.

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### **EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS)**

This substance is a recently notified product., No ELINCS number is available yet.

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### **CEPA - DOMESTIC SUBSTANCES LIST (DSL)**

All components in this product are in compliance with the DSL.

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## **15.2 STATE/LOCAL**

### **PENNSYLVANIA (WORKER AND COMMUNITY RIGHT-TO-KNOW ACT)**

This product is subject to the Worker and Community Right-to-Know Act. The following components of this product are at levels which could require identification in the MSDS:

<b>Component</b>	<b>CAS #</b>	<b>Amount</b>
Antimony compounds	Not available	<= 50.0000%

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### **MASSACHUSETTS (HAZARDOUS SUBSTANCES DISCLOSURE BY EMPLOYERS)**

The following components of this product appear on the Massachusetts Substance List and are present at levels which could require identification in the MSDS:

<b>Component</b>	<b>CAS #</b>	<b>Amount</b>
Benzene	71-43-2	<= 0.0010%

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### **CALIFORNIA PROPOSITION 65 (SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986)**

This product contains the following chemical(s) known to the State of California to cause cancer and birth defects or other reproductive harm.

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Component	CAS #	Amount
Benzene	71-43-2	<= 0.0010%

### **CALIFORNIA SCAQMD RULE 443.1 (SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULE 443.1, LABELING OF MATERIALS CONTAINING ORGANIC SOLVENTS)**

VOC: Vapor pressure <0.03 mmHg @ 20°C  
699 g/l VOC

*This section provides selected regulatory information on this product including its components. This is not intended to include all regulations. It is the responsibility of the user to know and comply with all applicable rules, regulations and laws relating to the product being used.*

## **16. OTHER INFORMATION**

### **16.1 AVAILABLE LITERATURE AND BROCHURES**

ADDITIONAL INFORMATION: Additional product safety information on this product may be obtained by calling your Union Carbide Corporation Sales or Customer Service contact.

### **16.2 SPECIFIC HAZARD RATING SYSTEM**

NFPA ratings for this product are: H - 2      F - 1      R - 0

HMIS ratings for this product are: H - 2      F - 1      R - 0

*These ratings are part of specific hazard communications program(s) and should be disregarded where individuals are not trained in the use of these hazard rating systems. You should be familiar with the hazard communication applicable to your workplace.*

### **16.3 RECOMMENDED USES AND RESTRICTIONS**

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FOR INDUSTRY USE ONLY.

### **16.4 REVISION**

Version: 3.1

Revision: 01/22/2001

Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

### **16.5 LEGEND**

A	Asphyxiant
Bacterial/NA	Non Acclimated Bacteria
F	Fire
H	Health
HMIS	Hazardous Materials Information System
N/A	Not available
NFPA	National Fire Protection Association
O	Oxidizer
P	Peroxide Former
R	Reactivity
TS	Trade Secret
VOL/VOL	Volume/Volume
W	Water Reactive
W/W	Weight/Weight

*The opinions expressed herein are those of qualified experts within Union Carbide. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of the use of the product are not under the control of Union Carbide, it is the user's obligation to determine conditions of safe use of the product.*